Scripps's Murrelet and Cassin's Auklet Reproductive Monitoring on Santa Barbara Island, California in 2015

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EXECUTIVE SUMMARY

- In the 2015 nesting season, 140 active Scripps's Murrelet (*Synthliboramphus scrippsi*; SCMU) nest sites were monitored on Santa Barbara Island. We could reliably determine the fates for 172 of the 177 clutches detected in 2015.

- In 2015, data were collected from Scripps's Murrelet nest sites at 5 monitoring plots: Arch Point-North Cliffs, Bunkhouse, Cat Canyon, Landing Cove, and Landing Cove Dock.

- The 2015 Scripps's Murrelet breeding season lasted 4.5 months (152 days) from first clutch initiation (20 February) to the latest monitored hatch date (22 July).

- Scripps's Murrelet clutch success was 74% (n=172 clutches) in 2015. Of all observed eggs laid in 2015, 70% hatched (n=290), and 24% were recorded as depredated by island deer mice (*Peromyscus maniculatus elusus*).

- Where both fate and egg order were known, depredation rates were higher for first eggs (25%, n= 113) than second eggs (19%, n=111).

- First clutches had slightly greater clutch success than second clutches, 75% compared to 72%, respectively.

- No social attraction was attempted for Cassin's Auklets (*Ptychoramphus aleuticus*; CAAU), and no auklet nesting was observed in any artificial burrow in 2015. Three artificial burrows in Landing Cove were utilized by nesting Scripps's Murrelets.

- Cassin's Auklets were found nesting in natural habitat at Arch Point-North Cliffs.

- In 2015, two Scripps's Murrelet clutches were found under vegetation in restoration plots. One nest was located in Landing Cove Restoration Plot (6 April 2016), and one nest in the Beacon Hill Restoration Plot above the Arch Point-North Cliffs murrelet monitoring plot (16 April). Scripps's Murrelet nests located in native shrub habitat within restoration plots successfully hatched both eggs, giving restoration plot habitat a nesting success of 100% (n=2). These represent the first active nest sites located in restoration plots on Santa Barbara Island since the project began in 2007.

- Scripps's Murrelets nested in three artificial burrows located in Landing Cove Restoration Plot, in artificial habitat originally placed to encourage nesting by Cassin's Auklets.

This report provides summary information of the results of monitoring efforts for seabird species, primarily Scripps's Murrelet and Cassin's Auklet. Other seabird species that were monitored will be summarized in less detail.

INTRODUCTION

At just under 2.6 km^2, Santa Barbara Island is the smallest of the eight islands in the Santa Barbara Channel off southern California (Figure 1). It is managed by Channel Islands National Park, along with four islands in the northern half of the archipelago.

Figure 1. Location of Santa Barbara Island within California Channel Islands. Images: Google Earth.

Santa Barbara had historically provided excellent breeding habitat for at least 13 species of seabirds, though two of these - Tufted Puffin (*Fratercula cirrhata*) and Rhinoceros Auklet (*Cerorhinca monocerata*) - are no longer observed nesting on the island (McChesney et al. 1995, Whitworth et al. 2011). Many factors influenced the use of the island by seabirds, including native shrub cover and associated root structure and abundant crevice habitat. This habitat paired with an absence of mammalian predators allowed seabirds to thrive in relative safety (Murray et al. 1983, Howard et al. 2015).

Near the turn of the 20th century, human activity on the island severely affected seabird populations and habitat. Early ranching activity included the introduction of feral cats, domestic dogs, and destructive non-native grazers like sheep and rabbits. While humans physically removed the native plants to make room for hay fields and crops, the sheep and rabbits consumed the natural plant communities. The absence of native cover released

Crystalline Iceplant (*Mesembryanthemum crystallinum*) from competition, and allowed it to spread over large portions of the island. Rabbits continued to destroy the native habitat after sheep were removed in 1922, and died out eventually, but were reintroduced a second time during the military presence on the island in the 1940's (Junak et al. 1993). Despite eradication efforts beginning in the 1950s, rabbits persisted on the island until 1981, and the last cat was removed in 1978.

The presence of these destructive alien species caused damage that has taken decades to show improvement. The Cassin's Auklet colony, once so numerous that "they had undermined almost every part of the soft, earthy surface with their burrows" (Howell 1917), was extirpated before 1911 (Willett 1912), and only since 1976 have small numbers of auklets been recorded sporadically nesting on the main island (Whitworth et al. 2011). Scripps's Murrelet numbers were likely also depressed by predator presence and were estimated at 3000 nesting birds (1500 pairs) in 1978 by Hunt et al. The population has been more recently estimated at closer to 1,200 nesting birds (600 pairs) (Whitworth et al. 2011).

In an effort to improve the nesting success of these seabirds, California Institute of Environmental Studies (CIES) began restoration activities on Santa Barbara Island in 2007 with funds from the Montrose Settlements Restoration Program and in cooperation with Channel Islands National Park and other partners. The goals of this collaborative effort are to restore seabird nesting habitat, attract seabirds to the restored sites, and to remove non-native plants (MSRP 2005). From 2007-2015, over 32,000 native perennial plants were outplanted in seven different restoration plots on the island, totaling over 8.3 acres. Details of this restoration work can be found in Jacques et al. 2015.

In conjunction with these restoration actions, monitoring of known nesting areas is performed to assess the current populations of these species, track their expansion, and inform future planting plans and restoration activities. If the above mentioned goals are to be met, monitoring of the seabird populations in and around the restoration sites is important to determine if these actions are indeed creating usable habitat for seabirds. This report presents the findings of the 2015 seabird monitoring season, comparisons to previous seasons, and recommendations for future activities.

BASIC BREEDING BIOLOGY OF STUDY BIRDS

Scripps's Murrelet. Described in detail in Murray et al. 1983, this is a brief synopsis of the major events of the Scripps's Murrelet nesting season.

Scripps's Murrelets begin to congregate below nesting habitat on Santa Barbara Island between late November and early December. Pairs call to one another, occasionally moving onto land to investigate and prepare nest bowls in crevices and under usable shrubs. As the nesting season approaches, the appearance of more well defined nest bowls indicates likely nesting locations. The first eggs are generally laid in February and the season continues through the final fledging chicks in June-July.

Upon successful nest site selection and copulation, the Scripps's Murrelet lays one egg in a small nest bowl of loose gravel or dirt. No improvements are made to the nesting site beyond the shaping of the slight depression and some debris removal from the immediate vicinity. Once the first egg is laid, both adults return to the water

to feed and the female develops a second egg. After approximately eight days, the female returns to lay the second egg, which completes the clutch.

Incubation usually begins within 2 days of clutch completion, and will last for 34. Both sexes incubate, trading shifts every couple of days.

After the egg is incubated to term, the eggs hatch within hours of each other. The chicks are then brooded in the nest for two days until the partner adult returns and the whole family group goes to the water. Chicks are not fed in the nest, and eggshells are left as evidence of occupancy.

Nest sites can be reused several times in a season. There has not been clear documentation as to whether these are replacement clutches due to at-sea chick mortality, or late breeders utilizing previously occupied nest sites.

Cassin's Auklet. Paraphrased from Ainley et al. 2011:

Cassin's Auklets are burrow nesting seabirds with a wide distribution from southern Baja California to the Aleutian Islands.

Though it is unknown which of the pair selects the nest site, both adults dig and prepare the burrow, and nesting pairs reuse the same burrow in consecutive seasons. A single egg is laid between January and May. Incubation lasts approximately 38 days, with both adults taking approximately 24 hour incubation shifts.

After hatching, the chick is brooded for a short time, and then left in the nest during the day. Adults feed the chick only at night. After 30-35 days, the chick begins exercising its wings, and can exit the nest burrow. Fledging occurs after 41-51 days in the nest, and is not necessarily associated with any parental assistance. Newly fledged chicks look virtually identical to their adult parents, except for fresher plumage and brown irises. During years of early spring conditions with good prey abundance, Cassin's Auklets have been known to raise more than one chick in a season (in other words double-clutch). Once fledged, the chicks are apparently independent of their parents.

METHODS

Scripps's Murrelet Reproductive Monitoring. Beginning in late February, researchers began weekly checks of murrelet habitat and known nesting sites on Santa Barbara Island. Each monitoring plot was checked once every 7 days, weather and scheduling permitting. All suitable habitat within the monitored plot boundaries was checked for activity until no new nest initiations were recorded for at least two weeks. Thereafter only active nests were tracked. Once all active nests came to completion, a final check of all suitable habitat within the boundaries of the monitored plot was made to detect any exceptionally late season nesting. Any additional nests that were found during this survey were monitored through completion. If no additional nests were detected during this survey, the monitoring schedule for that plot was ended.

Because murrelets utilize both shrub cover and rock crevices, all potential habitat within the study plots was searched by researchers using small flashlights and an assortment of mirrors, cameras, and other equipment to ascertain whether a nest site was occupied.

As in past years, a hand drawn map of known and historically checked sites was used to guide researchers to sites marked with small metal tags with the nest number stamped into it. All nests located were marked with these metal tags, which were either cemented into place on the rock face near the nest site entrance, or tied to shrub branches near the nest site. Shrub sites were also marked with pieces of flagging tape to aid in finding the tag, which can be cryptic.

Nest sites were identified by the physical presence of murrelet eggs or a nesting bird. Nest bowls and debris (feathers, eggshell fragments from previous seasons, etc.) were noted, but a site was not deemed active until occupancy was confirmed by the presence of fresh eggs or an adult murrelet.

Each week, researchers located and examined nest sites and habitat, and recorded nest site contents, picture numbers, measurements and comments pertinent to the monitoring trip into a Personal Digital Assistant (PDA) using Pendragon software. Data were also written on the site map as a backup. Previously active nest sites with no current activity were recorded as inactive, and these sites were marked on the map to assure that all sites were indeed checked. Once the plot was fully checked, the data from the PDA were synced to an Access database, and data were proofed against the map for accuracy. Maps were then prepared for the next week's check with active nest sites marked in advance. Unattended eggs that were accessible to researchers were removed from the nest site, photographed and marked with a permanent marker for identification in egg order and fate determination analysis. Each egg's length and width (at the widest point) were measured to the nearest tenth of a millimeter using calipers. Egg coloration was recorded as light, medium, or dark to aid in fate determination. Adult birds were noted and not handled to limit disturbance. Unattended eggshell fragments from depredated eggs or hatched eggs were recorded, photographed, collected, labeled appropriately, and were temporarily stored at Channel Islands National Park facilities. Eggshell fragments will most likely be housed at the Western Foundation of Vertebrate Zoology in Camarillo, California.

After the completion of the season, fate determinations were based on observed data and published timetables (Murray et al. 1983). Where eggs were determined to have failed (i.e., any fate but hatching), the primary cause of failure was determined based on the sequence and timing of the observed events. Murray et al. 1983 provided the required intervals of egg neglect, incubation and abandonment to determine the initial cause of failure versus any secondary causes. For example, the longest period of neglect Murray reported was 19 days, therefore any egg neglected for a shorter term that is then depredated is said to have been depredated as the cause of failure, not abandoned. An egg eaten after 20 days of neglect is considered failed due to abandonment, not depredation. Some egg fates cannot be determined reliably, due to a range of circumstances. These eggs were excluded from analyses of fate determination.

Each plot was analyzed separately to allow for comparisons to the previous year's nesting effort. All data used to compare to the 2014 nesting season was taken from Howard et al. 2015. The following metrics were used to describe seasonal reproductive parameters on Santa Barbara Island:

- **Hatch Success (HS)**: the percentage of observed eggs that hatched. This metric indicates the likelihood of any single egg surviving to hatch during the season.

- **Egg Depredation Rate (DR)**: the percentage of eggs that failed as a direct result of depredation. Depredation was determined to have occurred when tooth marks were observed on an unhatched eggshell with a shiny adherent membrane.

- **Clutch Success (CS)**: the proportion of clutches that hatched a minimum of one egg. This metric indicates the likelihood of any single nest hatching at least one egg.

Transportation to and from the island was conducted around the weekly boat schedule provided by the National Park Service, with periodic transportation provided by Aspen Helicopters in Oxnard, California. Monitoring staff was housed at Channel Islands National Park housing on Santa Barbara Island.

Scripps's Murrelet at-sea captures. Banding efforts for Scripps's Murrelets were conducted in May 2015 over the course of three survey nights (Table 2). Methodology continued to follow previous years' protocols based on Whitworth et al. 1997. Scripps's Murrelets were identified from the capture boat using a 1-million candle power hand-held spotlight and captured with a dip net. All banding occurred in the approach boat, a 14 foot Zodiac inflatable skiff with a 20hp Yamaha outboard engine. After extracting birds from the net, the bird was checked for brood patches, and the bird was banded with a USGS size 2 metal band. The bird was released immediately after banding. All capture and banding of birds was conducted under United States Geological Survey's Bird Banding Lab Permit #22539.

Spotlight Surveys. Spotlight surveys were modeled after Whitworth et al. 2014, using transects and waypoints from surveys conducted in 2009-2010 (Whitworth et al. 2011, Appendix 5). Surveys were conducted using a 14ft Zodiac inflatable boat with a 20hp Yamaha motor. A three person crew with skiff operator, spot lighter/observer and a data recorder began surveys approximately 1 hour after dark and navigated established transects using preloaded GPS points. The observer counted numbers of Scripps's Murrelets sitting on the water, flushing from the water, or seen flying across the field of view while moving a 1-million candle power hand-held spotlight in 90 degree arcs from the side of the boat forward on both port and starboard sides. The observer called out counts, and the data recorder recorded waypoints and murrelet counts, as well as any additional pertinent information. Transects ranged from 200-700m offshore of the island, and were designed to avoid submerged rocks and kelp beds and pass through areas in which murrelets congregate.

Infra-red nest cameras. Nest cameras are set up before the nesting season at consistently active Scripps's Murrelet nest sites in both the Landing Cove and Bunkhouse Plots. Set to record upon motion activation, the cameras are set to record 24 hour footage of nest behavior until a chick fledges from the nest or the nest fails. Nine cameras were set up in 2015, and video is archived at Channel Islands National Park.

Cassin's Auklet artificial burrows. One hundred artificial burrows are located at three locations on Santa Barbara Island: Elephant Seal Cove (20 units); Landing Cove (60 units); and Northeast Flats (20 units). These burrows were checked four times throughout the season, including a pre-season accessibility check to remove debris and mouse caches. There were no attempts to capture or band auklets in 2015 on Santa Barbara Island.

Ashy Storm-petrel mist-netting. Previous surveys and mist netting on Santa Barbara Island have shown that the cliffs and waters around the island are utilized by Ashy, Black, Leach's, and the occasional Least Storm-Petrel. In an effort to assess the Ashy Storm-Petrel population on Santa Barbara Island and across the Channel Islands, mist net efforts were coordinated with efforts at Scorpion Rock, Santa Cruz Island and at Prince Island, San Miguel Island. Capture nights were conducted as wind and weather permitted, and as close to the new moon phase as possible. Using one 2.6mx12m 75 denier/2 ply mist-net with a 30mm mesh (Avinet, Inc.) and audio attraction, storm-petrel mist net capturing efforts were conducted at Arch Point and Elephant Seal Point. Nets were opened at twilight, and remained active until 0200 the next day (approx. 5 hours effort per night). The net was watched for bird strikes, and any captured bird was immediately extracted. Measurements of mass, bill length, skull length, tarsal length, and wing chord were collected. A single USGS size 1a or 1b band was applied depending on species. Banded birds were released a short distance from the net.

California Brown Pelican Reproductive Monitoring. Land-based monitoring of California Brown Pelican (*Pelecanus occidentalis californicus*) was conducted through the nesting season. Discrete groups of nesting Brown Pelican were identified and counted every one to two weeks between 1 March and 23 August 2015. Numbers of adults, occupied and empty nests, and numbers and stages of chicks were collected from vantage points located far enough away as to not visibly affect the birds.

RESULTS

SCRIPPS'S MURRELET MONITORING PLOTS

In 2015, a total of 408 nest sites in five plots were monitored on a weekly basis throughout the murrelet nesting season. These plots were Arch Point-North Cliffs (APNC), Bunkhouse (BH), Cat Canyon (CC), Dock (DO), and Landing Cove (LACO) (Figure 2).

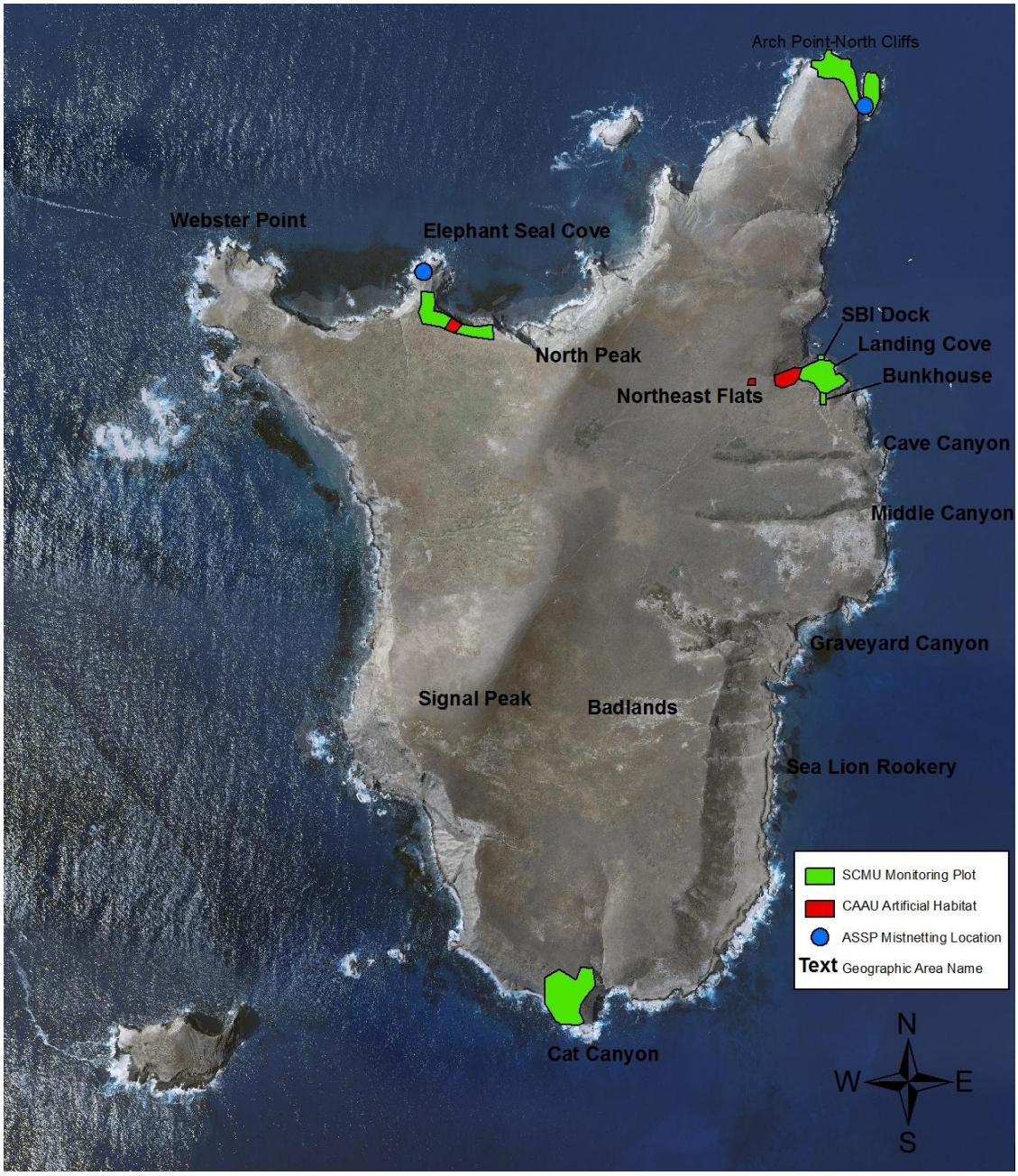

Figure 2. Overview map of Santa Barbara Island, including locations named in this report.

We conducted 94 surveys on 78 individual days between 25 February and 26 July (Table 1). Each survey included all potential habitat until 29 May, after which late season surveys recorded only active nests, and a final all-habitat check was performed after all monitored nests had completed their season. The Nature Trail, Northeast Flats, Landing Cove, and Beacon Hill Restoration plots were checked routinely for nesting evidence.

Table 1. Survey intervals in monitoring plots in 2015.

Monitoring Plot	Date Range	Interval (days)	End of Season Survey	Total Surveys
APNC	2/27 – 6/12	7	6/26	17
BH	3/4 – 6/24	7	7/1	18
CC	3/1 – 7/26	7 (6-8)	6/28	22
DO	2/25 – 6/18	7 (6-8)	6/24	18
LACO	3/3 – 6/30	7 (6-8)	7/7	19

APNC=Arch Point-North Cliffs; BH=Bunkhouse; CC=Cat Canyon; DO=Dock; LACO=Landing Cove

Arch Point-North Cliffs. The north-eastern point of Santa Barbara Island has been an active restoration site since 2010. Out plantings completed as recently as 2013 are large enough to provide adequate cover for Scripps's Murrelets, and such areas have been monitored for activity since 2014. The monitored active habitat was exclusively rocky crevice sites along the perimeter of the island up until April 2015 when researchers located a nest site in the restoration plot. The nest was located under a *Suaeda taxifolia* planted in 2013 (Figure 3, Figure 8).

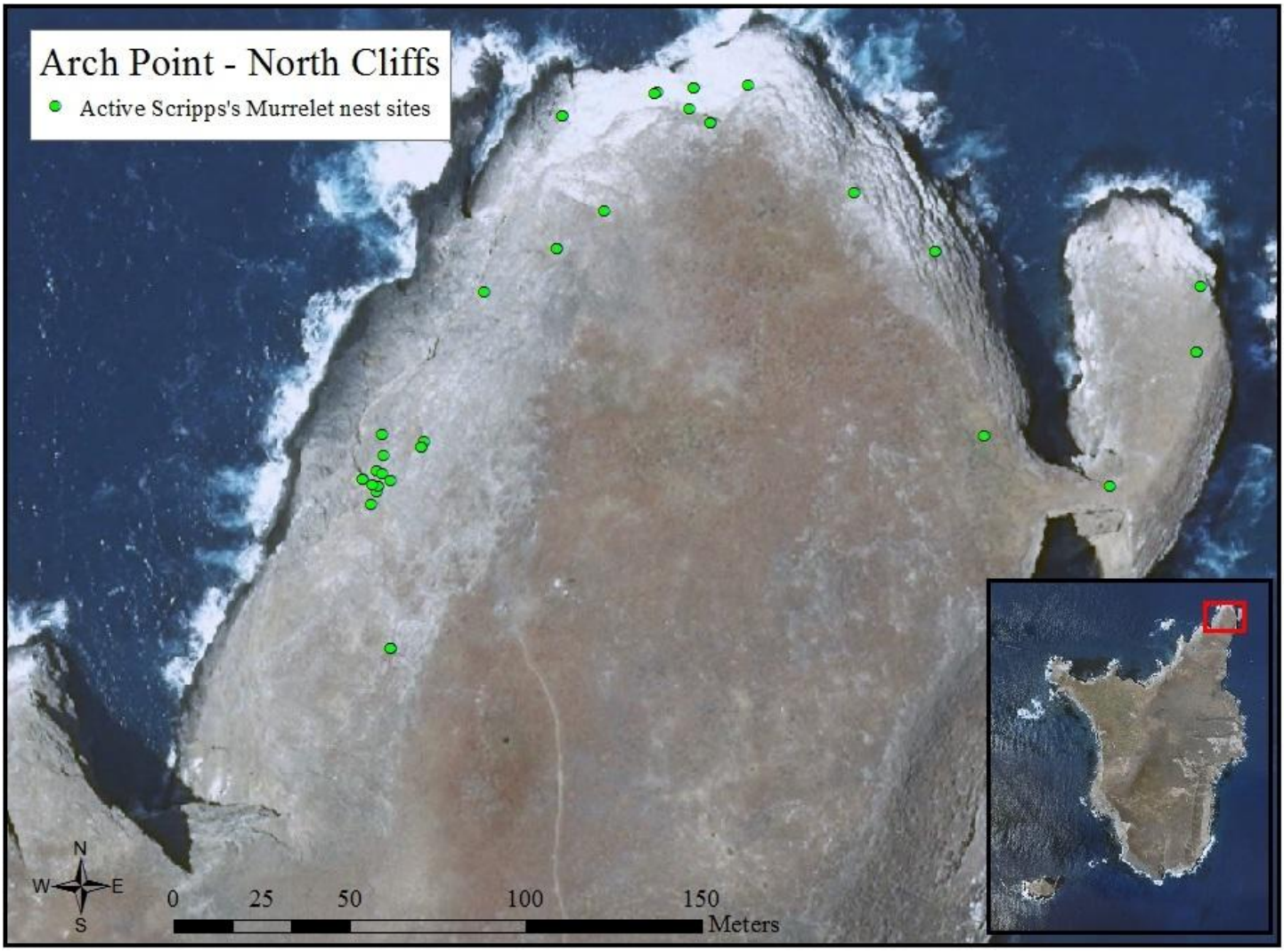

Figure 3. Map of Arch Point- North Cliffs active Scripps's Murrelet nest sites in 2015

Arch Point-North Cliffs was surveyed 17 times between 27 February and 12 June 2015, at an interval of 7 days (Table 1). A total of 56 previously marked sites at Arch Point-North Cliffs were checked during the nesting season. Six sites were removed from monitoring mid-season and four new sites were discovered in 2015. Nest searching located 29 active sites at Arch Point-North Cliffs, which housed 39 Scripps's Murrelet clutches (Table 4). Of these 29 active sites, ten sites were reused at least once during the season for a 34% rate of reuse. Hatch success and depredation rates were 58% and 32%, respectively (n=62 eggs, Table 4). Clutch success at Arch Point-North Cliffs was 68% (n=37 clutches with known fates, Table 4). Clutch success of first clutches was higher than second clutches (Table 5). First eggs were found depredated more often than second eggs (Table 7).

Arch Point-North Cliffs had higher attendance in 2015 than in 2014, with four more active sites and four more clutches than in 2014. Fewer eggs were depredated in 2015 than in 2014 (32% in 2015 vs. 42% in 2014), and as a result Hatch Success increased 12 percentage points to 58% in 2015 from 46% in 2014. Clutch Success similarly increased, up to 68% in 2015 from 59% in 2014.

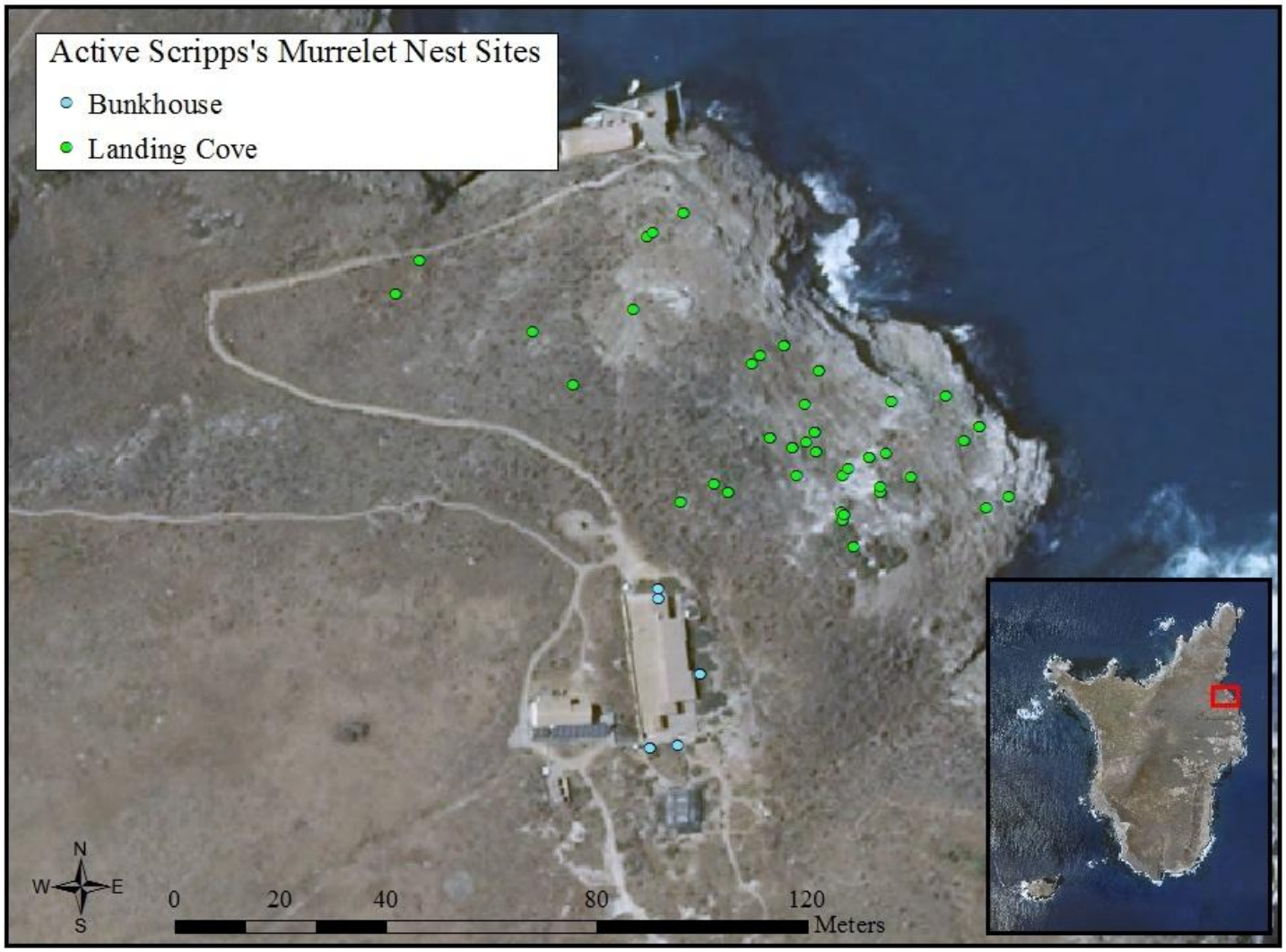

Figure 4. Map of Landing Cove active Scripps's Murrelet nest sites in 2015.

Landing Cove. Surveyed as a separate plot from the neighboring Bunkhouse and Dock plots, Landing Cove is located on the northeastern coast of the island. Nearly all available habitat is shrub cover, with very few crevice sites. Restoration adjacent to the monitoring plot was initiated in 2007, and the restoration area is surveyed during normal nest searching activities (Figure 4).

Landing Cove was surveyed 19 times between 3 March and 7 July 2015, at an interval of 7 days (Table 1). A total of 100 marked sites were checked at Landing Cove, including eight new sites located in 2015. The 41 active sites at Landing Cove housed 52 Scripps's Murrelet clutches (Table 4). Of 41 active sites, ten were reused during the season for a 24% rate of reuse (Table 5). Hatch success and depredation rates were 90% and 4%, respectively (n=84 eggs, Table 4). Clutch success at Landing Cove was 88% (n=51 clutches of known fate, Table 4). Clutch success of second clutches was slightly higher than first clutches (Table 5).

Attendance at Landing Cove was slightly higher in 2015 than in 2014, with one more active site and the same number of clutches. This location had higher success rates (both Clutch and Hatch) and much lower depredation rates than in 2014.

Bunkhouse. The Bunkhouse plot is located above Landing Cove, around the National Park Service housing area. The sites are located in artificial nest boxes, under housing structures, and among shrub habitat. Restoration activities have planted shrubs within this area, and native landscaping around the housing is large enough to provide habitat.

The Bunkhouse area was surveyed 17 times between 4 March and 24 June 2015, at an interval of 7 days (Table 1). A total of 35 marked sites around housing were checked each week. Nest searching located five active sites at the Bunkhouse, which housed eight Scripps's Murrelet clutches (Table 4). Of these five active sites, three sites were reused at least once during the season for a 60% rate of reuse. Clutch success at the Bunkhouse was 88% (n=8 clutches with known fates, Table 4). Hatch success was 71% and no eggs were depredated (n=14 eggs, Table 4). Clutch success of first clutches was higher than second clutches (Table 5).

The Bunkhouse had higher attendance in 2015 than in 2014, with one more active site and two more clutches than in 2014. No eggs were depredated in 2015, as in 2014. Hatch success increased quite a bit from 50% in 2014 to 71% in 2015. Clutch Success similarly increased from 60% in 2014 to 88% in 2015.

The Dock. The Dock plot, located at the bottom of Landing Cove, is mostly made up of artificial habitat in the form of nest boxes, cavities under the dock pilings, and one small cave above the deck.

This plot was surveyed 18 times between 25 February and 24 June 2015, at an interval of 7 days (Table 1). Searching a total of 33 marked sites at the Dock, researchers found 17 active sites resulting in 21 Scripps's Murrelet clutches (Table 4). Nests were laid in two artificial habitat types, with 66% in artificial nest boxes, and 34% under the dock structure (Table 8). Four sites were reused during the season for a 23% rate of reuse (Table 4). Clutch success at the Dock was very high at 95% (n=20 clutches, Table 4). Hatch success and depredation rates were 87% and 13%, respectively (n=39 eggs, Table 4). Clutch success of first clutches was lower than second clutches (Table 5). First eggs were depredated more often than second eggs (Table 7).

Attendance at the Dock was lower in 2015 than in 2014, with six fewer active sites and ten fewer clutches. Egg depredation decreased from 27% in 2014 to 13% in 2015. Hatch success increased from 61% in 2014 to 95% in 2015.

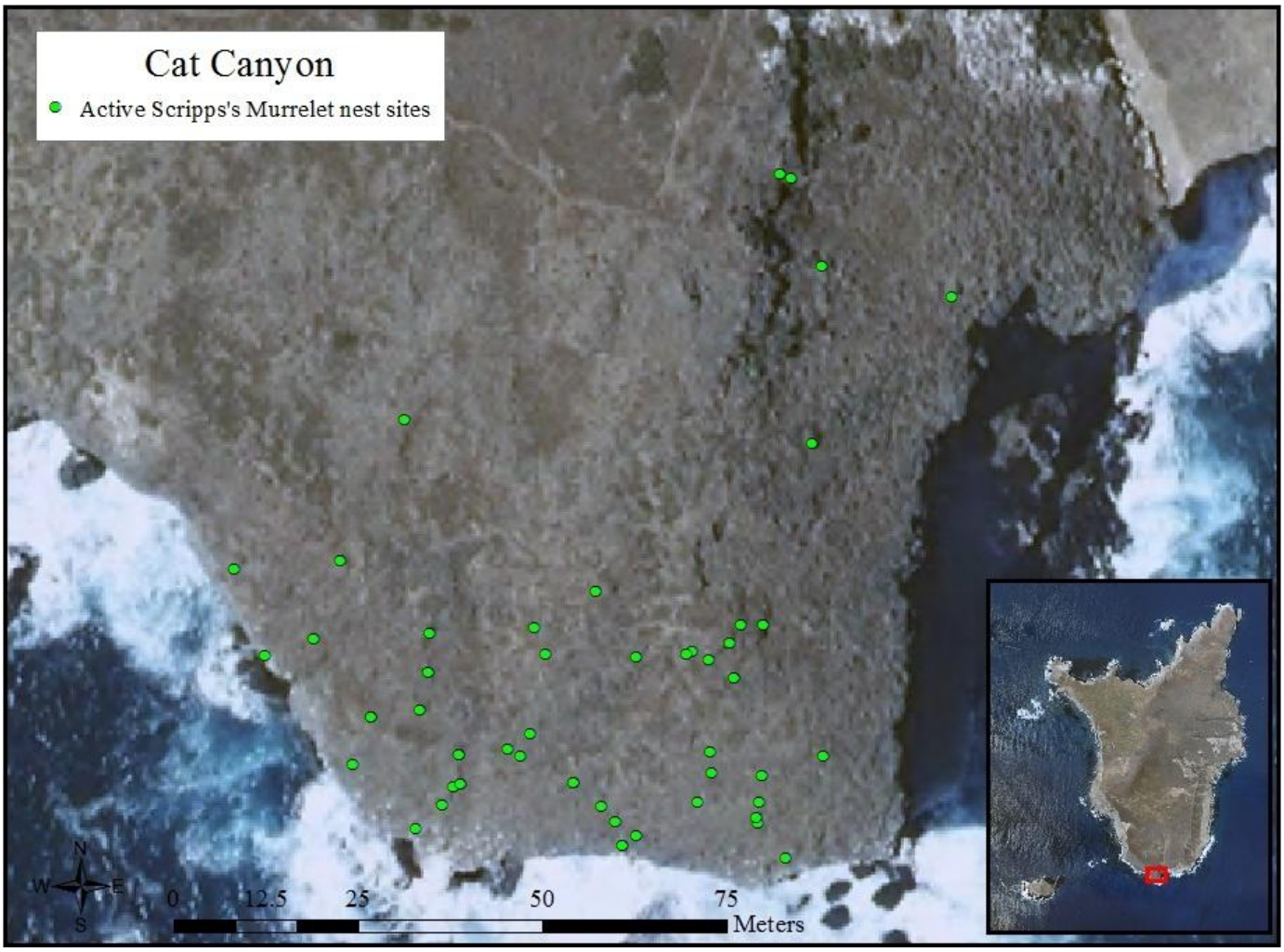

Figure 5. Map of Cat Canyon active Scripps's Murrelet nest sites in 2015.

Cat Canyon. The most southern monitored location on the island, Cat Canyon's nesting habitat is both rocky crevice and shrub cover. Shrub sites are comprised mostly of California Boxthorn (*Lyceum californica*) and Santa Barbara Island Buckwheat (*Eriogonum grande* var. *compactum*). No habitat restoration is currently underway at Cat Canyon or in its vicinity (Figure 5).

Cat Canyon was surveyed 18 times between 1 March and 28 June 2015, at an interval of 7 days (Table 1). An additional four checks of a single late nest were conducted through 26 July. A total of 187 marked sites at Cat Canyon were surveyed weekly, including two new sites discovered in 2015. The 48 active sites at Cat Canyon housed 57 Scripps's Murrelet clutches (Table 4). Of the 48 active sites located, nine were reused at least once during the season for a 19% rate of reuse (Table 4). Clutch Success at Cat Canyon was 57% (n=56 clutches, Table 4). Eighty percent of the nests were located in crevice habitat, with 20% in shrub habitat (Table 8). Hatch success and depredation rates were 51% and 47%, respectively (n=91 eggs, Table 4). Clutch success of second

clutches was slightly lower than first clutches (Table 5). First eggs were found to be depredated more often than second eggs (Table 7).

Cat Canyon had slightly lower attendance in 2015 than in 2014, with one less active site, and five fewer clutches. Clutch success was much lower in 2015 (57%) than 2014 (70%). The depredation rate increased to 47% (2015) from 33% (2014), with an associated decrease in hatch success to 51% (2015) from 60% (2014).

ISLAND-WIDE SCRIPPS'S MURRELET MONITORING RESULTS

Monitoring of the Santa Barbara Island Scripps's Murrelet population began on 25 February 2015, with the first eggs found that same day at the Dock. The nesting season lasted 152 days, through 22 July, when the last egg at Cat Canyon was calculated to have hatched (Tables 2, 3). The last day of monitoring was 26 July 2015.

Table 2. Scripps's Murrelet clutch initiation dates from all monitoring locations in 2015.

Statistic	Clutch Initiation Date (all clutches combined)	Clutch Initiation Date (first clutches only)
N	169	134
Earliest Day	2/20	2/20
Latest Day	6/9	5/7
Mean Day	3/24	3/21
SD (days)	24d	20d
Median Day	3/19	3/15

N=number of clutches for which a reliable clutch initiation date could be determined

Egg laying. The earliest date of clutch initiation (first egg laid) was calculated to be 20 February, and occurred at the Dock B18, an artificial nest box. The latest date of clutch initiation was 9 June, and occurred at Cat Canyon site 25. The median clutch initiation date, or the date at which 50% of all nests had been initiated, was 19 March. This means that 50% of all nests that would be occupied in the season were occupied in the first month of the season (27 days).

Table 3. Scripps's Murrelet hatching dates of first eggs at all monitoring locations in 2015.

Statistic	Hatch Date (all clutches combined)	Hatch Date (first clutches only)
N	125	100
Earliest Day	4/4	4/4
Latest Day	7/22	6/19
Mean Day	5/3	4/24
SD (days)	24d	15d
Median Day	4/24	4/23

N=number of first eggs for which a reliable hatch date could be determined

Egg hatching. The earliest and latest hatching dates were the same nests discussed above: Dock B18 hatched on 4 April, and Cat Canyon 25 hatched on 22 July. The median date for hatching was 24 April, which demonstrates that 50% of all nests that would hatch in the season did so in the 20 days after the first egg hatched.

Table 4. Scripps's Murrelet reproductive success at Santa Barbara Island in 2015.

Reproductive metric	APNC	BH	CC	DO	LACO	Total
Active Sites	29	5	48	17	41	140
Total Clutches	39	8	57	21	52	177
% Clutch Success (CS)[1]	68%	88%	57%	95%	88%	74%
Clutches tracked (n)[2]	37	8	56	20	51	172
Hatch Success (HS)[3]	58%	71%	51%	87%	90%	70%
Egg Depredation (DR)[4]	32%	0%	47%	13%	4%	24%
Eggs tracked (n)[5]	62	14	91	39	84	290
Clutches per active site	1.3	1.6	1.2	1.2	1.3	1.3

[1] percentage of clutches hatching at least one egg; [2] number of clutches monitored for which a reliable fate could be determined;
[3] percentages of eggs reliably observed to have hatched (includes chicks found dead after hatch)
[4] percentages of eggs reliably observed to have been depredated; [5] only known fate eggs were counted

Reproductive success. We monitored 177 SCMU clutches in 140 active nest sites on Santa Barbara Island in 2015 (Table 4). Island wide clutch success was approximately 74% (n=172 clutches). A total of 290 individual eggs were observed and tracked through the season (Table 4). Seventy percent of all observed eggs laid in 2015 hatched, though approximately 3% of chicks were later found dead in the nest (Table 6). Hatch success was highest at Landing Cove and lowest at Cat Canyon (Table 4).

A subset of nest sites was reused during the season. The number of clutches per site varied from 1.2 to 1.6, and 37 of the 140 active sites were reused at least once during the season, for a 26% rate of reuse. Clutch success (where it could be calculated based on known egg fates) of first clutches was marginally higher than second clutches, 75% vs. 72%.

Table 5. Clutch success of first and second clutches within discrete nest sites in 2015.

Clutch	APNC	n	BH	n	CC	n	DO	n	LC	n	Total	n
1	70%	27	100%	5	57%	47	94%	16	88%	41	75%	136
2	60%	10	67%	3	56%	9	100%	4	90%	10	72%	36
Total	68%	37	88%	8	57%	56	95%	20	88%	51	74%	172

n= number of individual nesting attempts within each clutch category

Of all observed eggs laid in 2015, 24% were recorded as depredated by mice. This was the single most significant source of failure, followed by abandonment (4%, n=120; Table 6). Where fate and egg order were known, depredation rates were expectedly higher for first eggs (33%, n= 120) than second eggs (18%, n=120; Table 7). Conversely, hatch success was higher for second eggs (69%; n=120) than first eggs (50%; n=120, Table 7)

Table 6. Scripps's Murrelet egg fates at Santa Barbara Island in 2015.

Fate	APNC	BH	CC	DO	LC	Total	% of Total
Hatched[1]	34	10	45	33	72	194	66%
Failed[2]	27	4	46	5	9	91	31%
Abandoned[3]	6	2	2	0	3	13	4%
Addled[4]	0	2	0	0	1	3	1%
Broken Egg	0	0	0	0	1	1	0.3%
Depredated	20	0	43	5	3	71	24%
Disappeared[5]	1	0	1	0	1	3	1%
Chick died in nest	2	0	1	1	4	8	3%
Total	63	14	92	39	85	293	

[1] Chick not found dead, assumed successfully made it to ocean
[2] Total number of eggs that failed to hatch, does not include chicks that died after hatching
[3] Eggs observed that lacked evidence of incubation for >19days after laid
[4] Eggs observed to have not hatched after full incubation period
[5] Unknown fate, not used in known fate calculations

Table 7. Fate of first and second Scripps's Murrelet eggs on Santa Barbara Island in 2015.

Depredated	APNC	BH	CC	DO	LC	Total
Egg 1	39%	0%	48%	16%	0%[1]	25%
Egg 2	17%	0%	45%	11%	0%[1]	19%
Hatched	**APNC**	**BH**	**CC**	**DO**	**LC**	**Total**
Egg 1	48%	80%	48%	84%	97%	70%
Egg 2	70%	80%	52%	89%	100%	77%

[1] Egg order was not determinable for the eggs found depredated in Landing Cove

Clutch success relative to habitat type. Of the 177 individual clutches observed in 2015, 87 were located in rock crevices, 64 in native shrub sites, 14 in artificial nest boxes, and 12 were located under manmade structures (e.g. the Landing Cove Dock, Table 8). Clutch success was highest in artificial habitat, which was limited to artificial box nests at the Dock. In natural habitat, shrub cover provided more productive sites (CS=86%) with lower depredation rates (DR=2.4%). Less successful nest sites were found in natural crevice sites where depredation rates were highest (CS=61%, DR=20.3%, Table 9).

Table 8. Scripps's Murrelet nest site types at Santa Barbara Island in 2015.

Site Type	**APNC**	**BH**	**CC**	**DO**	**LC**	**Total**
Artificial Habitat	-	-	-	14	-	14
Crevice	38	-	46	-	3	87
Shrub	1	3	11	-	49	64
Under structure	-	5	-	7	-	12
Grand Total	**39**	**8**	**57**	**21**	**52**	**177**

Table 9. Scripps's Murrelet egg depredation rates (DR) and clutch success (CS) by site type and plot at Santa Barbara Island in 2015.

		CS per Monitoring Plot					
Site Type	DR	APNC	BH	CC	DO	LC	Total
Artificial Habitat	1.0%	-	-	-	93%	-	93%
Crevice	20.3%	67%	-	53%	-	100%	61%
Shrub	2.4%	100%	100%	73%	-	88%	86%
Under structure	0.7%	-	80%	-	100%	0%	91%
Total	24.5%	68%	88%	57%	95%	88%	74%

SEABIRD MISTNETTING AND AT-SEA CAPTURES

Scripps's Murrelet. In 2015, spotlight captures were attempted on 3 nights, 8-11 May. During these efforts, 64 individuals were captured, 58 of which resulted in a new band being deployed. Six murrelets were recaptured, five of which were from previous years' banding efforts. Recaptures were recovered from efforts in 1995-1996, 2010, 2012, and 2014. See Appendices 2 and 3 for details of Scripps's Murrelet banding efforts in 2015.

Storm-Petrel species. On 9 nights between 12 June and 10 September, 97 new bands were deployed on Ashy Storm-Petrels. In addition to Ashy Storm-Petrels, 17 Black Storm-Petrels, 1 Leach's Storm-Petrel, and 2 Western Gulls were netted but not banded. Please see Appendices 2 and 4 for details of Ashy Storm-Petrel banding efforts in 2015.

SPOTLIGHT SURVEY

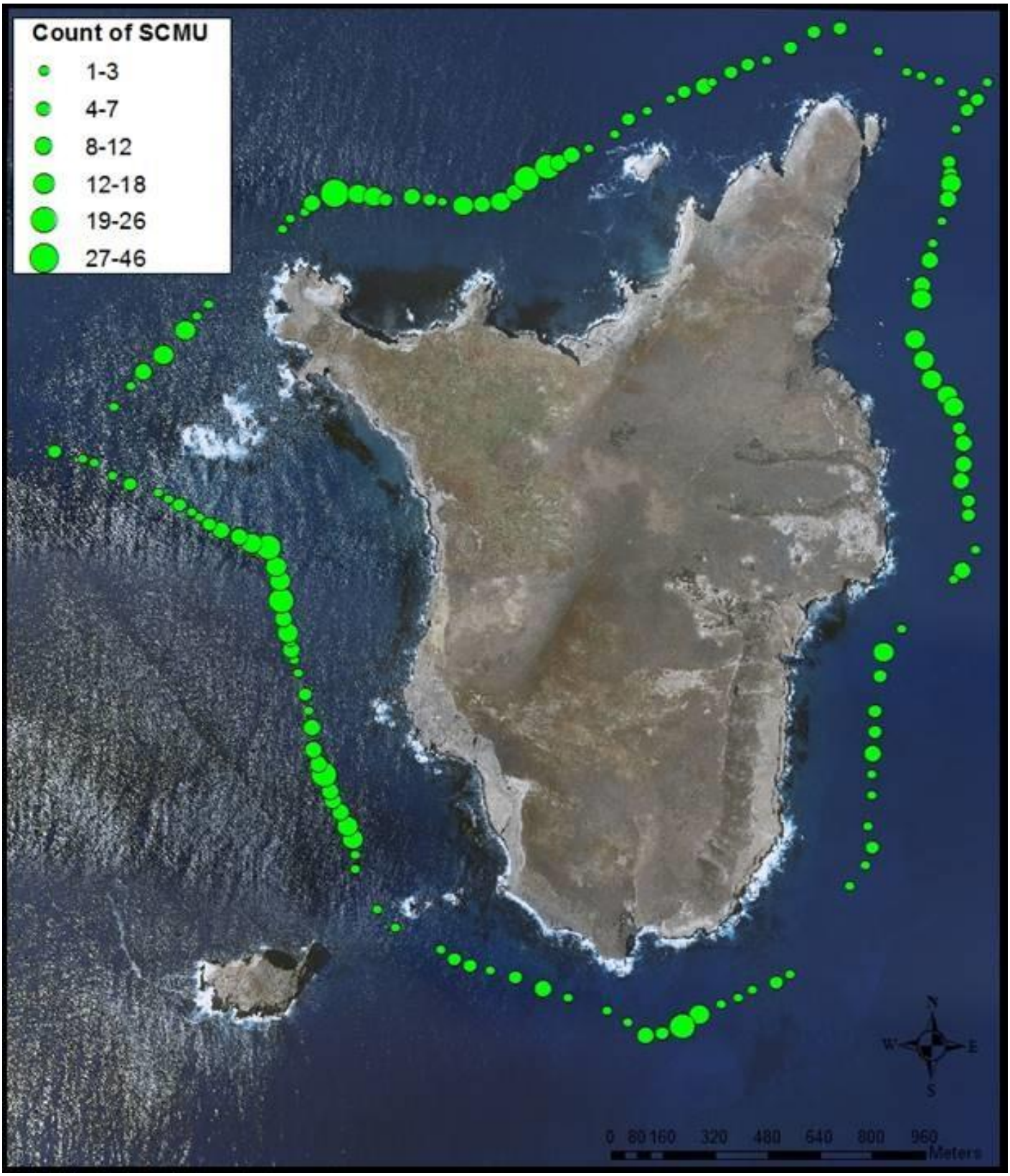

Figure 6. Scripps's Murrelet locations and densities during spotlight survey on 11 April 2015.

Weather and staff availability restricted spotlight surveys to two nights in 2015, 9 April and 11 April. On 9 April, the survey was only partially completed due to equipment failure. As a result, we were only able to complete one round-island survey. A total of 1,053 murrelets were counted in the waters surrounding the island on 11 April. On that night we recorded 737 birds sitting on the water, 164 flushing from the water, and 119 in flight. Spotlight surveys in 2009-2010 (Whitworth et al. 2011) produced an approximation factor of 0.40-0.52 nests per adult bird observed during the spotlight surveys. Applied to the 1,053 adult murrelets observed on 11 April 2015, this would indicate that an estimated 421-547 breeding pairs were present during the survey. Our one 2015 survey fit within the range suggested by the 2009-2010 surveys which estimated 321-638 pairs for Santa Barbara Island (Whitworth et al. 2011).

Large numbers of birds were counted near the cliffs below Signal Peak and from Webster to Elephant Seal Cove (Figure 6). These are areas that are not regularly surveyed for nesting murrelets, but they do appear to have available rocky crevice habitat, mature scrub habitat, and dry sea caves suitable for nesting.

CASSIN'S AUKLET NESTING

Cassin's Auklet monitoring on Santa Barbara Island in 2015 was restricted to incidental observation of auklets within the scope of Scripps's Murrelet monitoring efforts as well as monitoring of 100 artificial burrows installed at three restoration plots: Landing Cove, Northeast Flats, and Elephant Seal Cove.

Arch Point-North Cliffs. Four sites (APNC 1303, 1333, 1337 and 1063) had evidence of auklet nesting. APNC 1063 contained a visible egg for two consecutive checks, but was found depredated on 10 April. Auklet feathers appeared in APNC 1337 on 15 May. Eggshell fragments were visible but could not be examined for fate determination in APNC 1333 on 10 April. APNC 1303 contained an adult on 6 March, and successfully fledged a chick after 15 May.

Artificial Habitat. Artificial burrows were checked and cleaned before the season on 22 January 2015, and any mouse nests, clogged entrances, or seed caches were removed to make the unit available for prospecting auklets. These units were checked on 12 February, 14 April, and on 4 July 2015. No nesting activity by Cassin's Auklets was observed in any artificial burrow on Santa Barbara Island in 2015. Three of these structures in Landing Cove were used by Scripps's Murrelets, which shows that the sites were not unusable, just not selected by auklets.

ASHY STORM-PETREL NESTING.

Nest searches and monitoring for Storm-petrels was restricted to incidental observation within Scripps's Murrelet monitoring protocols. No additional effort was attempted to assess storm-petrel nesting at Santa Barbara Island in 2015.

Arch Point - North Cliffs. Only one site (APNC 1332) was documented to have Ashy Storm-Petrel activity. This site held an adult on the weekly checks during March, and again from May through June. Monitoring efforts ended before an egg or chick was observed.

CALIFORNIA BROWN PELICAN NESTING.

The first congregating pelicans on Santa Barbara Island were observed on 1 March between Graveyard Canyon and the Sea Lion Rookery. Monitoring began on 24 March when eggs were first observed. Peak attendance

occurred mid to late April, with approximately 105 occupied nests in the monitored areas (Graveyard Canyon Mouth, the first drainage south of Graveyard Canyon, and the Sea lion Rookery Bench drainage). End of season nest counts found 140 active nests for the island, including Middle Canyon and the area between Middle and Graveyard Canyons.

Peak chick counts occurred in late June with a high count of 113, including the newly located population in Middle Canyon. No verified chick carcasses were seen during the season, and no new carcasses were located during the end of season check. A total of 113 fledged chicks from 119 active nests in the monitored areas resulted in 0.95 chicks per nesting attempt. Applying this rate to the end of season count of 140 active nests, approximately 131 California Brown Pelican chicks fledged from Santa Barbara Island in 2015.

The California Brown Pelican data will be reported in more detail separately to include the entire Channel Islands breeding range. Data presented in this report is only for preliminary informational purposes.

DISCUSSION

Project goals for the seabird habitat restoration program on Santa Barbara Island are to increase native cover and nesting habitat for seabirds, attract seabirds to these restored locations and to remove non-native plants in these areas to reduce the chances of reverting back to non-native dominated landscapes. Success in landscape restoration can take a long time, particularly with slow growing island scrub plants in a location without a reliable source of fresh water. Adding to the challenges are changing variables such as oceanographic and climatic conditions that can influence seabird nesting success in a given year. These factors can make restoration goals difficult to reach, or even define success for. Non-native species removal is a long-term goal that requires combating the annual seedlings of persistent and prolific plants like *Mesembryanthemum*.

In 2015, after nine years of restoration actions, more than 8.3 acres of the island replanted with 35,000+ native plants, and thousands of volunteer and staff hours, we documented successful nesting in the restoration sites. On 6 April 2015, researchers located the first egg laid within the boundaries of the Landing Cove restoration plot. Located in Subplot F0, the egg was located under a Woolly Sea-blite (*Suaeda taxifolia*) planted in 2007 and hand watered until it was established (Figure 7). A few days later, on 16 April 2015, researchers located the second nest in a restoration plot at Arch Point North Cliffs. This nest was located under a Woolly Sea-blite planted in 2013 and placed on drip irrigation soon after (Figure 8). In addition to the benchmark of seabirds nesting in the created habitat, it is important to note that both nests hatched both eggs.

Figure 7. Photo of habitat at first observed nest site at Landing Cove Restoration Plot F0

Figure 8. Photo of habitat at first observed nest site at Beacon Hill Restoration Plot F4 (Arch Point-North Cliffs)

These discoveries provide evidence that the trajectory of the project is in the right direction, and with future seasons to monitor these new sites, we will be able to track and compare the colony expansion across sites. From these first selected sites, we could potentially add to our understanding of the parameters these species use to identify suitable habitat, with an indication of how long after planting we can reasonably expect to see nesting.

In general, 2015 was a relatively successful year for the Scripps's Murrelet population of Santa Barbara Island. Higher clutch success and hatch success meant a larger percentage of eggs laid left the island as chicks than in many previous years (Figure 9). However, there were also slightly fewer nesting pairs of murrelets in the monitored plots. Most locations had fewer active sites and total numbers of clutches than in 2014. Although the average nest success was higher than in years past, fewer numbers of actual nests might mean that no more chicks entered the population than in a higher volume, lower success year. As the species has been documented to have declined significantly in the recent past from an estimated 1500 pairs in 1978 to an estimated 600 pairs in 2003 (Schwemm et al 2005, Whitworth et al. 2003, Hunt et al 1978), this is something to watch for in future seasons.

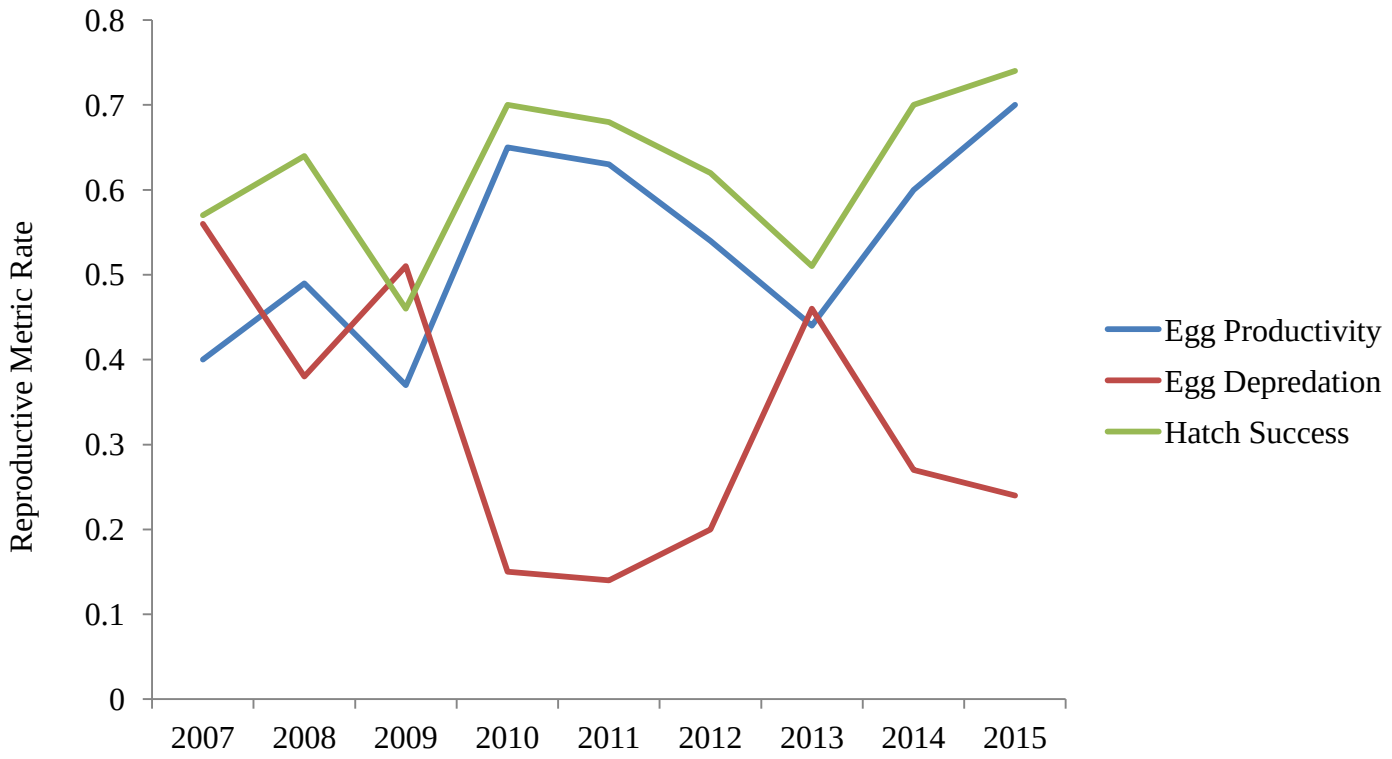

Figure 9. Reproductive success of Scripps's Murrelets 2007-2015

Similar observations of the California Brown Pelican nesting season were documented in 2015. The season was characterized by lower nest numbers than recent years, with small clutches (1-2 chicks), but with low mortality observed, and high fledging success. In 2014, the number of nests identified in the same monitored areas was double the number observed at the high point of 2015 attendance (235 nests in 2014, versus 119 in 2015).

Despite the lower number of active nests, it appears that more chicks survived to fledge in 2015 than in the previous year.

In contrast to the Scripps's Murrelet, efforts to encourage the Cassin's Auklet to expand its nesting territory have not been successful. Artificial burrows augmented with nocturnal audio attraction were initially successful at encouraging a small number of auklets to nest within the Landing Cove restoration plot in 2010-11. The program was suspended after native Barn Owls began preying upon the colony. Since audio attraction was halted in 2011, very few auklets have been documented in Landing Cove. Placement of artificial burrows at the Beacon Hill restoration plot, or the reintroduction of audio attraction while low numbers of Barn Owls are present on island may be worth revisiting if we are to see measurable success in recovering a colony of this species during this project.

RECOMMENDATIONS FOR FUTURE MONITORING EFFORTS

Scripps's Murrelet. As stated in previous reports, continuing to monitor and report on the success of this species is an important part of assessing the goals of this program (Harvey et al. 2014, Howard et al. 2014, 2015). Continuing to utilize the same protocols as in previous years and collecting comparable data to the existing data set is important to track the trajectory of the Santa Barbara population of Scripps's Murrelets, and watch for indications of further declines or recovery. The basic metrics described above (clutch success, hatch success, and depredation rate for individual plots and the island as a whole) should be considered required for reporting each year in timely reports.

The five plots (Arch Point-North Cliffs, Bunkhouse, Cat Canyon, Landing Cove, and the Landing Cove Dock) should continue to be monitored every season, to give a large enough data set to represent the island population as a whole. If a larger effort could be made, supplemental monitoring plots at Elephant Seal Cove, West Cliffs, and Webster Point, along with shoreline surveys at the Arch Point rock fall and more sea caves around Santa Barbara Island could be checked for nesting birds.

Spotlight surveys were conducted in 2009 and 2010, and can give a more robust estimate of the whole island population of murrelets. Periodic surveys have been done at Anacapa Island, San Clemente Island and many of the Baja California Pacific Islands in Mexico. Coordinating these efforts across the species breeding range could give us important information on the status of the whole population of Scripps's Murrelets. A few surveys during the peak of colony attendance would be an easy addition to the monitoring protocol and allow for better comparison to other nesting locations as well.

Continuing the mark-recapture data set provides valuable survivorship and longevity data, and has been conducted since the 1970s. Continuing to schedule banding efforts after the peak of laying should continue to provide high numbers of capture opportunities while lowering risk to the birds' eggs. Captures have been focused on the area immediately around Landing Cove. Maintaining this location as the epicenter for murrelet banding efforts at Santa Barbara Island might be preferable for recapture opportunities rather than expanding the capture arena due to the logistics involved, the short window of feasibility in the season, and the murrelet's philopatric nesting behaviors.

Infra-red nest cameras have been installed in active sites in Landing Cove for five consecutive seasons. These can provide excellent data on time budgets, pair interactions, nest predator interactions, and other behavioral data. These videos are being analyzed by students at the Karnovsky Lab at Pomona College, California, providing both data analysis for this project and learning opportunities for future field biologists. Continued placement of these cameras at active nest sites will provide unique opportunities to document the nesting behavior of these birds that is not possible any other way.

Eggshells collected at nest sites can be used to investigate eggshell thinning, stable isotopes, and population genetics and help fill in other gaps in the understanding of this species. These eggshells have been collected as part of the monitoring protocol since 2010, and funding for analysis to address these topics would help fill in our understanding of the species. A sample of eggshells collected during this monitoring program is being analyzed for shell thickness at the Western Foundation of Vertebrate Zoology in Camarillo, CA.

The biggest obstacle to hatching success of murrelets (and likely other seabirds on Santa Barbara Island) continues to be the native island deer mouse population. We recommend that this relationship and the deer mouse population continue to be studied to watch for trends detrimental to the future survival of seabird species. Additionally, avian predators should continue to be monitored as well, as both Barn Owls and Peregrine Falcons nesting on the island have been shown to prey on alcids during the nesting season (Thomsen and Harvey 2012, Thomsen et al. 2013).

Cassin's Auklet. One of the major goals of the habitat restoration project on Santa Barbara Island is to restore an historic colony of Cassin's Auklets. It should remain a priority to plant native shrubs that provide the ground stabilizing root structures auklets benefit from for nesting. Placing these out-plantings in appropriate locations for auklet utilization should also continue to be a priority.

A more active attempt to locate and monitor auklet burrows could be beneficial to future restoration efforts by identifying candidate locations for auklet habitat restoration that are adjacent to current auklet nesting areas. At a minimum, more passive monitoring effort could be expended in the form of Audio Recording Units and Infra-red Motion Cameras in locations of likely auklet activity. Audio attraction, while discontinued because of Barn Owl predation, might be a viable option in seasons with low owl populations, since the brief time it was used was successful in attracting nesting auklets.

Storm-Petrel species. Mist netting efforts to band Ashy Storm-Petrels have identified the island as being used by Ashy, Black, and Leach's Storm-Petrels and should continue to be done in coordination with efforts on Santa Cruz and San Miguel Islands. There is no current nest searching program for storm-petrels on Santa Barbara Island. A breeding season survey during the peak of season (July-August) on cliffs and sea caves that could be safely assessed could give additional information for the populations on Santa Barbara Island and may be used to compare to the longer term data set from Santa Cruz Island. Audio recording units could help in locating and estimating small colonies in otherwise hard to monitor locations.

Spotlight surveys for other species have had some success at locating storm-petrels, and surveyors should continue to note when these birds are observed.

General recommendations for actions to benefit the SBI seabird colonies. Past reports have identified the issues concerning the Santa Barbara seabird colonies (Harvey and Barnes 2009, Harvey et al. 2012, 2013b, Howard et al. 2014, 2015). One of the most important issues is disturbance, whether by light, noise, or physical presence. Seabirds do not spend a lot of time on land, and their ability to tolerate disturbance varies from species to species. A Scripps's Murrelet might sit motionless as its nest is checked, but a Brandt's Cormorant might flush when a researcher appears 100 meters away. Individual Western Gulls may react to human presence by remaining on the nest and vocalizing, while another gull from the same subcolony might expend a lot of energy diving at the intruder, leaving their eggs or chicks vulnerable to predation. Because of the variety of responses both between individuals and species, the most conservative approach is recommended for reducing disturbance during the nesting season.

Island visitors, whether staff, volunteers, or the general public, should be properly informed about the current conditions on the island. Visitors to Santa Barbara Island are generally aware and interested in the conservation and rehabilitation of the island's native ecosystem, and it is important to keep them informed and engaged. During the seabird breeding season, visitors should be educated about the risks and issues regarding the disturbance of these species and not be allowed to enter or investigate nesting colonies that would be adversely affected by their presence. Researchers needing to traverse colonies should do so with as little disturbance as possible, and they should be properly trained in both how to avoid disturbance and what protective equipment is to be used. Recreational visitors should be informed of the need to stay on trails, and never be allowed to investigate the cliffs or canyons on the island, for their own safety as well as the birds' well-being. Island Naturalist Volunteers with the Park Service should be informed of any trail closures and the need to enforce them. Whenever possible, Island Naturalist Volunteers should accompany any hikers that plan on approaching sensitive areas, and provide information and context as to why these animals should not be disturbed.

Ideally, seasonal closures of seabird nesting areas should be established early in the season, and thoroughly explained to island staff, cooperators, researchers, and the public. Any seasonal trail closures should be well marked, with explanatory signs placed in the center of the trail, and updated maps at the visitor center and kiosk. Updates to NPS staff, cooperators, researchers, and the public should be given as appropriate, and closures lifted as soon as nesting completes.

Trail closures from 22 May- 19 July of 2015 (2 months) were the same areas as in 2014. These closures were short term, and minimally impacted the experience of island visitors. The trail from the campground to Signal Peak and down to Cat Canyon remained open, as did the trail from the campground to Arch Point. North Peak, Webster Flats, and the Badlands (the SE section of the island) were closed to protect the nesting sites of Western Gull, Brown Pelican, Double-crested Cormorant, and Brandt's Cormorant. Closures were marked on visitor maps (Figure 10), incorporated into the visitor information kiosk, and explained to island visitors during orientation and outreach conversations.

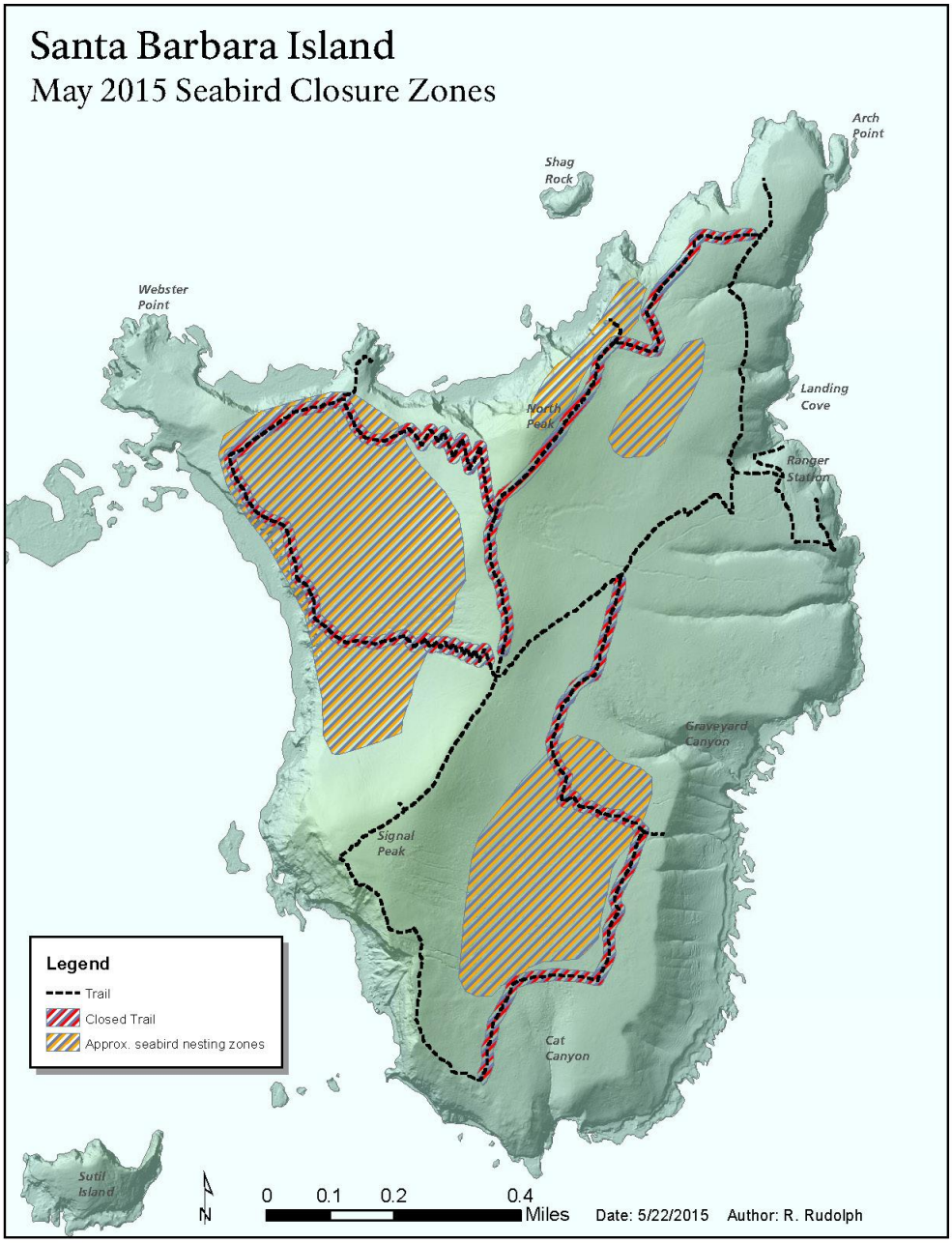

Figure 10. Map of temporary trail closures on Santa Barbara Island in 2015. Credit R. Rudolph, Channel Islands National Park GIS Specialist

Reductions in light pollution, including outdoor lighting as well as light emanating from inside the housing area, should be avoided as much as possible. Black-out curtains have been installed on all housing windows, and should be in good repair and used at night year round to reduce bird strikes. External lights at the dock and hallways should be turned off at night. Harvey et al. (2014) recommended informing private boaters of the hazards associated with lights at sea for these seabirds.

Noise pollution should also be avoided whenever possible. Loud engines, power tools, and other sources of noise should be mitigated as much as possible, and avoided unless necessary. With the potential wilderness

designation for Santa Barbara Island, the use of power tools will be restricted, and this should become less of an issue for the birds.

Proper organization of building materials at housing and near the dock is essential for seabird safety, and avoiding unfortunate accidents. Crevice nesters will use woodpiles, jumbles of trash and debris, and any other solid looking structure with large enough holes to incubate in. Proper organization helps ensure that birds will not be caught or accidentally crushed in the nest site when moving material.

Conclusion. Continued seabird monitoring, especially of the species identified as targets in the habitat restoration program on Santa Barbara Island, should be a priority through the end of the project, and hopefully beyond. This monitoring creates the record that shows where projects like these are succeeding, and where more effort or different ideas should be implemented. Reducing disturbance and increasing the usable habitat for the island's murrelet and auklet populations will help encourage their expansion and recovery.

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Appendix 1. Survey dates for Scripps's Murrelet monitoring in 2015.

DATE	APNC	BH	CC	DOCK	LACO	DATE	APNC	BH	CC	DOCK	LACO
2/25/2015						5/6/2015					
2/27/2015						5/7/2015					
3/1/2015						5/8/2015					
3/3/2015						5/10/2015					
3/4/2015						5/12/2015					
3/6/2015						5/13/2015					
3/8/2015						5/15/2015					
3/10/2015						5/17/2015					
3/11/2015						5/19/2015					
3/13/2015						5/20/2015					
3/15/2015						5/22/2015					
3/16/2015						5/24/2015					
3/18/2015						5/26/2015					
3/20/2015						5/27/2015					
3/23/2015						5/29/2015					
3/25/2015						5/31/2015					
3/27/2015						6/2/2015					
3/29/2015						6/3/2015					
3/31/2015						6/5/2015					
4/1/2015						6/7/2015					
4/3/2015						6/9/2015					
4/5/2015						6/10/2015					
4/6/2015						6/12/2015					
4/8/2015						6/14/2015					
4/10/2015						6/16/2015					
4/12/2015						6/17/2015					
4/14/2015						6/18/2015					
4/15/2015						6/21/2015					
4/17/2015						6/23/2015					
4/19/2015						6/24/2015					
4/20/2015						6/26/2015					
4/22/2015						6/28/2015					
4/24/2015						6/30/2015					
4/27/2015						7/1/2015					
4/28/2015						7/5/2015					
4/29/2015						7/7/2015					
5/1/2015						7/12/2015					
5/3/2015						7/19/2015					
5/5/2015						7/26/2016					

= Regular weekly survey

= End of Season survey

Appendix 2. Details of banding efforts at Santa Barbara Island in 2015.

Survey Night	Target Species	Start Time	End Time	New Bands Deployed	Recaptures	Total
5/8-9/2015	SCMU	22:29	3:50	22	6	28
5/9-10/2015	SCMU	22:17	2:00	18	0	18
5/10-11/2015	SCMU	22:20	2:04	18	0	18
6/12-13/2015	ASSP	21:15	2:00	21	2	23
6/13-14/2015	ASSP	20:15	1:05	7	0	7
7/9-10/2015	ASSP	20:11	2:00	11	1	12
7/22-23/2015	ASSP	21:00	2:00	18	0	18
7/23-24/2015	ASSP	21:00	2:00	16	0	16
8/8-9/2015	ASSP	20:25	2:00	12	0	12
8/9-10/2015	ASSP	20:30	2:10	11	0	11
9/10-11/2015	ASSP	21:07	0:55	1	0	1
9/11-12/2015	ASSP	21:03	0:47	0	0	0

Appendix 3. Scripps's Murrelet bands deployed/recaptured in 2015 at Santa Barbara Island.

New Bands Deployed				Recaptures	
Band Number	Banding Date	Band Number	Banding Date	Band Number	Capture Date
1262-03745	5/8/2015	1262-03774	5/9/2015	0892-9810*	5/9/2015
1262-03746	5/8/2015	1262-03775	5/9/2015	1322-22056	5/9/2015
1262-03747	5/8/2015	1262-03776	5/9/2015	0892-98338	5/9/2015
1262-03748	5/8/2015	1262-03799	5/9/2015	1262-03760	5/9/2015
1262-03749	5/8/2015	1262-03777	5/10/2015	1262-03262	5/9/2015
1262-03750	5/8/2015	1262-03778	5/10/2015	1262-03433	5/9/2015
1262-03751	5/8/2015	1262-03779	5/10/2015		
1262-03752	5/9/2015	1262-03780	5/10/2015	* last digit not recorded in notebook	
1262-03753	5/9/2015	1262-03781	5/10/2015		
1262-03754	5/9/2015	1262-03782	5/10/2015		
1262-03755	5/9/2015	1262-03783	5/10/2015		
1262-03756	5/9/2015	1262-03784	5/10/2015		
1262-03757	5/9/2015	1262-03785	5/10/2015		
1262-03758	5/9/2015	1262-03786	5/10/2015		
1262-03759	5/9/2015	1262-03787	5/10/2015		
1262-03760	5/9/2015	1262-03788	5/10/2015		
1262-03761	5/9/2015	1262-03789	5/10/2015		
1262-03762	5/9/2015	1262-03790	5/10/2015		
1262-03763	5/9/2015	1262-03791	5/10/2015		
1262-03764	5/9/2015	1262-03801	5/11/2015		
1262-03765	5/9/2015	1262-03802	5/11/2015		
1262-03766	5/9/2015	1262-03803	5/11/2015		
1262-03767	5/9/2015	1262-03804	5/11/2015		
1262-03768	5/9/2015	1262-03792	5/11/2015		
1262-03769	5/9/2015	1262-03793	5/11/2015		
1262-03770	5/9/2015	1262-03796	5/11/2015		
1262-03771	5/9/2015	1262-03797	5/11/2015		
1262-03772	5/9/2015	1262-03798	5/11/2015		
1262-03773	5/9/2015	1262-03800	5/11/2015		

Appendix 4. Ashy Storm-Petrel bands deployed or recaptured in 2015 at Santa Barbara Island.

Band Number	Banding Date	Band Number	Banding Date	Band Number	Banding Date
4501-41735	06/12/2015	4501-37863	07/10/2015	4501-37897	07/24/2015
4501-41736	06/12/2015	4501-37864	07/10/2015	4501-37898	07/24/2015
4501-41737	06/12/2015	4501-37865	07/10/2015	4501-37899	07/24/2015
4501-41741	06/12/2015	4501-37866	07/10/2015	4501-37900	07/24/2015
4501-41743	06/12/2015	4501-37867	07/10/2015	1971-02701	07/24/2015
4501-41748	06/12/2015	4501-37868	07/22/2015	1971-02702	08/08/2015
4501-41749	06/12/2015	4501-37869	07/22/2015	1971-02703	08/08/2015
4501-41750	06/12/2015	4501-37870	07/22/2015	1971-02704	08/08/2015
4501-41752	06/12/2015	4501-37871	07/22/2015	1971-02705	08/08/2015
4501-41190	06/12/2015	4501-37872	07/22/2015	1971-02706	08/08/2015
4501-41191	06/12/2015	4501-37873	07/22/2015	1971-02707	08/08/2015
4501-41192	06/12/2015	4501-37874	07/22/2015	1971-02708	08/08/2015
4501-41193	06/12/2015	4501-37875	07/22/2015	1971-02709	08/09/2015
4501-41194	06/13/2015	4501-37876	07/22/2015	1971-02710	08/09/2015
4501-41195	06/13/2015	4501-37877	07/22/2015	1971-02711	08/09/2015
4501-41196	06/13/2015	4501-37884	07/23/2015	1971-02712	08/09/2015
4501-41197	06/13/2015	4501-37885	07/23/2015	1971-02713	08/09/2015
4501-41198	06/13/2015	4501-37886	07/23/2015	1971-02714	08/09/2015
4501-41199	06/13/2015	4501-37887	07/23/2015	1971-02715	08/09/2015
4501-41200	06/13/2015	4501-37888	07/23/2015	1971-02716	08/09/2015
4501-41795	06/13/2015	4501-37889	07/23/2015	1971-02717	08/09/2015
4501-41796	06/13/2015	4501-37890	07/23/2015	1971-02718	08/09/2015
4501-41797	06/13/2015	4501-37891	07/23/2015	1971-02719	08/09/2015
4501-41798	06/13/2015	4501-37892	07/23/2015	1971-02720	08/10/2015
4501-41799	06/13/2015	4501-37893	07/23/2015	1971-02721	08/10/2015
4501-41800	06/13/2015	4501-37894	07/23/2015	1971-02722	08/10/2015
4501-37855	06/13/2015	4501-37895	07/23/2015	1971-02723	08/10/2015
4501-37856	06/13/2015	4501-37878	07/23/2015	1971-02724	08/10/2015
4501-37857	07/09/2015	4501-37879	07/23/2015	1971-02741	09/10/2015
4501-37858	07/09/2015	4501-37880	07/23/2015		
4501-37859	07/09/2015	4501-37881	07/23/2015	**Recaptures**	
4501-37860	07/09/2015	4501-37882	07/23/2015	4501-41750	06/12/2015
4501-37861	07/09/2015	4501-37883	07/23/2015	4501-41196	06/13/2015
4501-37862	07/10/2015	4501-37896	07/24/2015	4501-37861	07/10/2015

Appendix 5: Waypoints and coordinates for spotlight surveys at Santa Barbara Island. Taken from Whitworth et al. 2011.

Waypoint	Latitude - Longitude
SB200A	N33° 29’ 20.5” - W119° 01’ 30.3”
SB200B	N33° 28’ 57.2” - W119° 01’ 36.9”
SB200C	N33° 28’ 49.3” - W119° 01’ 31.2”
SB200D	N33° 28’ 35.8” - W119° 01’ 29.0”
SB200E	N33° 28’ 25.7” - W119° 01’ 39.7”
SB200F	N33° 28’ 05.2” - W119° 01’ 40.9”
SB200G	N33° 27’ 54.1” - W119° 01’ 48.2”
SB200H	N33° 27’ 47.0” - W119° 02’ 04.7”
SB200J	N33° 27’ 57.0” - W119° 02’ 37.4”
SB200K	N33° 28’ 18.3” - W119° 02’ 48.0”
SB200L	N33° 28’ 34.2” - W119° 02’ 52.2”
SB200M	N33° 28’ 43.4” - W119° 03’ 16.9”
SB200N	N33° 29’ 09.1” - W119° 02’ 48.6”
SB200O	N33° 29’ 09.2” - W119° 02’ 27.3”
SB200P	N33° 29’ 18.8” - W119° 02’ 08.3”
SB200Q	N33° 29’ 27.2” - W119° 01’ 47.1”